Rhodora

JOURNAL OF THE
NEW ENGLAND BOTANICAL CLUB.

Conducted and published for the Club, by

BENJAMIN LINCOLN ROBINSON Editor-in-chief.

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Vol. 7. March, 1905. No. 75.

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Boston, Mass. 740 Exchange Building. | Providence, R. I. Preston and Rounds Co.

Printed by Edward W. Wheeler, Cambridge, Mass.

RHODORA.—A monthly journal of botany, devoted primarily to the flora of New England. Price $1.00 per year ($1.25 to all foreign countries except Canada); single copies 15 cents. Volume 1, $1.50. All remittances by check or draft, except on Boston or New York, must include ten cents additional for cost of collection. Notes and short scientific papers, relating directly or indirectly to the plants of the northeastern states, will be gladly received and published to the extent that the limited space of the journal permits. Forms will be closed five weeks in advance of publication. Authors (of more than one page of print) will receive 25 copies of the issue in which their contributions appear. Extracted reprints, if ordered in advance, will be furnished at cost.

Address manuscripts and proofs to
B. L. ROBINSON, 3 Clement Circle, Cambridge, Mass.

Subscriptions, advertisements, and business communications to
W. P. RICH, 300 Massachusetts Avenue, Boston, Mass.

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JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 7 March, 1905 No. 75

ON BALLS OF VEGETABLE MATTER FROM SANDY SHORES.

W. F. Ganong.

It happened some two or three years ago that I received at about the same time from two different sources inquiries as to the mode of formation of certain balls of vegetable matter found on the sandy bottoms of shallow ponds. Having myself no knowledge of the subject I sought for some description of them in the accessible literature, but without result. Nor did inquiries addressed to those of my colleagues likely to be versed in such matters elicit any substantial information. Following the subject further, however, I did obtain some facts about them, and, since other interests are not likely to allow me to investigate their mode of formation for myself, I desire to place these facts on record for the benefit of others who may wish to make use of them.

The earliest, and at the same time almost the only, published reference to the balls known to me occurs in Thoreau's well-known book, *Walden*, the first edition of which appeared in 1854. In the Chapter on Ponds, in a description of Flint's or Sandy Pond in Lincoln, Mass., he writes: —

There also I have found, in considerable quantities, curious balls, composed apparently of fine grass or roots, of pipewort perhaps, from half an inch to four inches in diameter, and perfectly spherical. These wash back and forth in shallow water on a sandy bottom, and are sometimes cast on the shore. They are either solid grass, or have a little sand in the middle. At first you would say that they were formed by the action of the waves, like a pebble; yet the smallest are made of equally coarse materials, half an inch long, and they are produced only at one season of the year. Moreover, the

waves, I suspect, do not so much construct as wear down a material which has already acquired consistency. They preserve their form when dry for an indefinite period.

Apparently this is Thoreau's only published reference to the balls. But I am informed by Mr. Francis H. Allen, of West Roxbury, that Thoreau's manuscript Journals now in his possession in preparation for publication by Messrs. Houghton, Mifflin & Co., contain two additional references to them, and these references, by Mr. Allen's kind aid and permission, are here reproduced: —

Feb. 4, 1857. Met Theodore Parker in the cars, who told me that he had recently found in Lake Michigan a single ball five inches in diameter like those I presented to the Natural History Society, though he did not observe the eriocaulon. It was late in the season.

Apr. 5, 1858. In the proceedings of the Natural History Society for December, 1856, there were presented by Dr. H. R. Storer 'a globular concretion of grass said to have been formed by the action of waves upon the sea shore'. Were not these some obtained by the Hoars or Emersons from F. Pond?

The reference in this passage is to the *Proceedings of the Boston Society of Natural History*, Vol. 6 (published 1857), page 93, where the citation given by Thoreau occurs. The specimen itself, however, is not now in the Society's Museum, as I am informed by the Secretary, Mr. Glover M. Allen.

The mention of the balls in a work so notable as *Walden* has apparently drawn much attention to them locally, and has led those of Thoreau's readers who possess scientific tastes to desire further information concerning them. It was for this reason that the first of these balls I had seen were sent me by Miss Madge Palmer of the Packer Collegiate Institute, of Brooklyn. Somewhat later I received a letter (Oct. 5, 1901) on the subject from the late Alfred W. Hosmer of Concord (who speaks of them as grass balls), in the course of which he writes:

The *eastern* side of the pond [Flint's or Sandy Pond] is a shallow place, the bottom of a hard white sand, covered with ripple marks. In these ripple marks there collects decayed eriocaulon, or duck grass, and the prevailing winds in summer being *west*, these bits of decayed grass are gently rolled together, and as the ball forms, it begins a wider rolling, gathering new bits on its way, until they form balls from one to four inches in diameter. If they keep under water while in process of formation, they keep spherical, but if they are washed up to shore, the action of the waves flattens them. Break one open while wet, and it cannot be made to adhere again and will go to

pieces; break one while dry, and it holds. All I have opened have been composed of the same substance all through, and of the quantity I have picked up in the past 8 or 10 years, only two have had a different substance in them. One had a portion of a chestnut burr, and the other a piece of a woody plant with roots on it — the plant was dead, however — this one is egg shaped. As the balls begin to form they are very loosely put together but become matted from long rolling. I find them the latter part of August and first of September, only in the one section of the pond, and then only when the pond is full..... As to their keeping qualities when dry, there is one in the possession of the Concord Antiquarian Society that Thoreau found, and he has been dead 39 years.

Another account of the formation of the Sandy Pond balls has been sent me by Mr. Joseph S. Richardson of Concord, Mass. He confirms Mr. Hosmer's statements excepting as to the precise place of occurrence of the balls, which Mr. Richardson places in a cove at the north side of the pond. More recently I have been able to see, through the courtesy of Professor B. L. Robinson of the Gray Herbarium, a MS. description of these balls, without date, written by William A. Hart and now in the library of the Gray Herbarium. After describing their formation from Eriocaulon stems, the author adds:

The broken stems first collect in the little ripples of the sand; then a changed direction of waves gives them a new motion and they soon form into spheres or cylinders. After attaining some size they roll freely about, in water about two feet deep and less, on the bottom and continue to collect more material. Naturally they form in coves where the eddying of waves is suited for the varied motion necessary to form them. They were discovered by the writer in Sandy Pond, Lincoln, Mass., and so far as he can learn occur elsewhere only in Lake Geneva, Switzerland.

This reference to the occurrence of such balls in Lake Geneva is not confirmed by any information I possess, nor do I know Mr. Hart's authority for the statement, which, however, is very likely correct.

Yet another, and in some respects markedly different description of the Sandy Pond balls has been sent me by Mr. Lincoln Ware Riddle, of Cambridge, Mass., who writes: —

In the summer of 1898 I found over twenty specimens on the northern shore of Sandy Pond, Lincoln, Mass. They are called by the people of that neighborhood, "Burr Balls." There is comparatively little Eriocaulon growing in Sandy Pond; but the shores, especially to the north are bordered by a large number of chestnut trees.

I should say that the balls were composed chiefly of the debris of the chestnut burrs, with some admixture of the veins of rotted leaves. I have found them from an inch in diameter, in which case they are flattened and loosely compacted, up to six inches, when they are perfectly spherical and closely compacted. The northern shore of the pond is shallow for a long distance out, and the prevailing southerly winds of summer would roll the waves on the shore. The summer of 1898 was one of extreme low water; the following years the water rose several feet, and I was unable to find a single Burr ball.

Mr. Riddle is evidently not certain as to the composition of the Sandy Pond balls, and while it is entirely possible that some composed of the debris of chestnut burrs may occur in the pond, it is likely they are all of Eriocaulon, as the other observers have stated. Certainly the several specimens I have received from Mr. Hosmer and Mr. Richardson, and one of which is figured on the accompanying plate, are composed of Eriocaulon almost exclusively.

So much for the information I have obtained about the balls from Sandy Pond. Meanwhile I was shown at Fredericton by Professor L. W. Bailey, of the University of New Brunswick, a very fine specimen, of similar formation but very different material, said to have been found in Kedron Lake in the southwestern part of York County, New Brunswick. Following up the matter I found that it had been obtained by Mr. Wellington Davis of Brockway, N. B., from Little Kedron Lake, and on application to Mr. Davis he sent me a fine specimen together with the following account of its formation: —

It is found in the north end of Little Kedron Lake in a small cove. No wind can strike the cove but from the southeast. It is surrounded with fir and spruce which hang over the water. The bottom is a clear sand. The spills drop from the fir and spruce and lie at the bottom. Then the water washing from side to side forms the ball. No heavy swell comes in there. These balls can be found in no other place in the Little Kedron Lake nor in Big Kedron Lake. Sometimes we have found them from six to eight inches through.

This account, with other matter relating to this subject (practically all included in the present paper), together with a plate showing the ball beside one from Sandy Pond, were published in the *Educational Review* (St. John, N. B.) for August, 1904 (page 51), and it appears in somewhat altered form in the *Bulletin of the Natural History Society of New Brunswick*, No. XXIII, 1905. As Mr. Davis states, the balls consist almost exclusively of the spills (*viz.* leaves or needles) of the spruce, which are interlocked in a very compact and fairly tenacious mass. It is very remarkable that such smooth objects

can thus cling together, but still more remarkable that they should become interlocked in this way in the first place; and one suspects that some cement of micro-organisms must be present to account for their cohesion, something of which the dried specimens show no evidence.

Desiring information as to other localities, or as to other published references to the subject, I published in *Science* for April 8th (1904), a letter asking for such information. It was this letter which brought me the welcome information above given from Mr. Allen and Mr. Riddle; and, in addition, Mr. F. V. Coville of Washington referred me to similar balls from lakes in Idaho, and gave me the name of a botanist, Mr. John B. Leiberg of Athol, Idaho, who was acquainted with them. On application to Mr. Leiberg he kindly wrote me (May 5, 1904) as follows: —

Balls and solid cylinders composed, in the main, of decaying pine needles, bits of comminuted bark and wood, *Ceratophyllum demersum*, leaves and stems of Potamogeta, Charas and Nitellas are of common occurrence in Lake Pend Oreille, in Idaho, and doubtless in Priest and Coeur d'Alene lakes also, in the same State. The balls are small affairs — 4 to 7 centimeters in diameter — while the cylinders vary from 30 to 40 centimeters in length, with diameters from 3 to 5 centimeters. Owing to the great depth of the lakes the balls and cylinders are formed near the shores in water less than 1 meter in depth, and mostly in late summer and fall; the strong gales and heavy wave motion of early winter soon destroy them. The nucleus both of balls and cylinders consists of broken and tangled bits of *Ceratophyllum*, Charas and Nitellas, occasionally mixed with strands of *Zannichellia* and *Naias*. The wave motion rolls the mixture along the bottom and in its progress shoreward pine-needles, decaying splinters of wood bark and similar debris are taken up and become intimately mixed with the primary mass. Infusorial slimes — Amoebas, Vorticellas, etc.— develop and assist in holding the mass together. It is finally cast up on shore where wind and wave soon bring about its disintegration. The balls and cylinders have no local designation.

Mr. Leiberg's account, it will be observed, apparently leaves little to be said as to the mode of origin of the balls in the lakes of his region.

All of the balls so far described occur in fresh-water lakes. I have however seen a specimen, of apparently a similar general nature, from a sea-beach. It was sent me by Mr. Francis H. Allen, and is from Ipswich Beach. As compared with the lake balls I have seen, it is much smaller, far less regular, and of much coarser and more hetero-

geneous materials, — in fact little more than a loosely-matted collection of flotsam hardly brought to a true ball by wave-action.

There remain to add a few facts about vegetable balls of a totally different morphological origin, of which three distinct kinds are known to me. *First*, there are the photo-bezoars, mentioned occasionally in botanical literature, which are formed of matted grass-awns, cactus-bristles, etc. in the stomachs of herbivorous animals. *Second*, the letter in *Science*, above mentioned, was followed by two-others in later numbers of that journal (XIX, 926 and XX, 86) by J. Adams of the Royal College of Science of Dublin, giving references to balls formed by the alga Cladophora in Scottish and Danish Lakes. I am informed, however, by Professor F. E. Lloyd and by Dr. M. A. Howe, that the balls formed by these Algae, of which there are specimens in the Museum of the New York Botanical Garden, are of a character quite different from that of the ones we are here considering, for the balls of Cladophora are the result of the normal mode of growth of the plant, and are not simply mechanically-produced aggregations. *Third*, Mr. John H. Sears, of the Peabody Museum at Salem, Mass., writes me (Feb. 9, 1905) that he finds on Ipswich and other beaches a kind of vegetable ball, or "pebble," formed from the matted sods of *Juncus Gerardi*, or Black Grass, thrown upon beaches in ditching operations. These sods are rolled about, worn down and rounded by action of the waves; and they may in addition pick up in the process various other materials,— grass fragments, bits of wood, fish-bones and even sand. Obviously such balls are very different in origin from those of the fresh-water ponds. Mr. Sears also adds that he has found vegetable balls on the shores of Wenham Lake.

There are, therefore, at least four morphologically distinct modes of origin for balls of vegetable matter, and very likely there are also others.

Returning for a moment to the particular kind here under consideration, it seems plain from the descriptions cited that they are simply an incidental mechanical result of the rolling about of light water-logged materials on sandy bottoms by the under-water parts of waves, aided perhaps as to their cohesion by the development of glutinous micro-organisms. On this basis the balls ought to occur wherever this combination of conditions is found, and hence in some parts of most shallow sandy-bottomed lakes; and it is surprising that

they appear to have been so little observed. While this is their probable mode of origin, the subject should by no means be allowed to rest with conjecture, but the genesis and growth of the balls should receive precise scientific study and adequate description.

Smith College, Northampton, Massachusetts.

AN UNDESCRIBED NORTHERN COMANDRA.

M. L. Fernald.

In July, 1903, Mr. George H. Richards collected in the sandy alluvium of the Grand River, Gaspé County, Quebec, a white-flowered *Comandra*, which in habit suggested both *C. umbellata*, Nutt., of the Atlantic States and *C. pallida*, A. DC., of the extreme West. The specimens were not, however, satisfactorily referable to either of those species; so in late June and early July when, with Mr. Richards, I visited the salmon-camp of Mr. Louis Cabot, the present owner of the Seigniory of Grand River, we made it a special point to search for the strange *Comandra*. The plant was found at several stations, but only occasionally in flower. Later in July, it was found in dry sandy woods at Tadousac, at the mouth of the Saguenay, and in September was collected in ripe fruit at the same station.

Study of this *Comandra* of eastern Quebec shows that it is a plant of broad northern range, extending across Canada to Saskatchewan and Assiniboia, south to the Great Lakes, Missouri, and Kansas. Throughout this extensive range the plant holds the characteristics noted on the Grand River and at Tadousac. Compared with *C. umbellata* of the Eastern States,—from central Maine to Wisconsin and Georgia—the more northern species is low, the fertile branches 0.5–2.5 dm. high, those of *C. umbellata* ranging from 1.5–4 dm.; the more crowded leaves are thicker, scarcely paler beneath, and when dry with green inconspicuous reticulate veins, the fewer thinner leaves of *C. umbellata* being somewhat whitened beneath and with the pale midrib prominent beneath. The inflorescence of the northern plant is a rather dense corymb, made up of 2–6-flowered cymules on strongly ascending rays; that of *C. umbellata* is an ellipsoid-oblong panicle with the cymules of smaller more numerous flowers on divergent rays.

This northern plant has only a superficial resemblance to the western whitish-green much firmer-leaved *Comandra pallida*; but it is the plant which has been generally taken by botanists of eastern and central Canada for *C. umbellata*, and under that name it was beautifully illustrated by Hooker in his Flora Boreali-Americana. There is a bare possibility that Michaux also may have had before him specimens of this northern plant when he named his *Thesium corymbulosum*, with "fasciculis florum corymbuloso-terminalibus,"[1] but he cited *T. umbellatum*, L. (*Comandra umbellata*, Nutt.) as a pure synonym and made no other provision for the common Alleghanian plant. Furthermore, there is apparently nothing to show for Michaux's species in his very complete herbarium at the Jardin des Plantes in Paris; and it is probable that, as in case of his *Anychia dichotoma* (*Queria canadensis*, L.), *Monarda coccinea* (*M. didyma*, L.), *Campanula amplexicaulis* (*C. perfoliata*, L.) etc., Michaux's name, *Thesium corymbulosum*, was intended merely as a substitute for the obviously inappropriate Linnean name, *T. umbellatum*.

Rafinesque, in characteristic language, announced in 1836 that "the *Thesium umbellatum* of L. has been well described as a N. G. *Comandra* by Nuttal, but he neglected the species thereof, and so have done all our botanists, there are now 7 or 8 sp. of this G. and I will distinguish 5 sp. of it, all blended by our careless Authors."[2] So far as it is possible to interpret Rafinesque's descriptions, his 5 species seem to be phases of the Alleghanian *Comandra umbellata* and not at all referable to the more northern representative of that plant. This northern species, apparently, has never received the distinctive name it deserves, and I now take pleasure in associating with it the name of is discoverer in eastern Quebec, through whose interest it was possible for me to study the plant in the field.

COMANDRA **Richardsiana**. Rootstocks elongate, freely branching, superficial or very slightly covered by the loose soil: flowering branches slender, 0.5–2.5 dm. high, very leafy: the strongly ascending green leaves from lanceolate to ovate, obtuse or acute, firm, with obscurely reticulate green veins: inflorescence corymbose, 1–3 cm. broad, of 1 to 6 2–6-flowered cymules on strongly ascending rays: bracts lance-subulate to ovate, mostly exceeding the short pedicels: calyx 3–5 mm. long, cleft to the middle into 5 oblong white (or finally

[1] Michx., Fl. Bor.-Am. i, 112.

[2] Raf., New Fl. ii, 33.

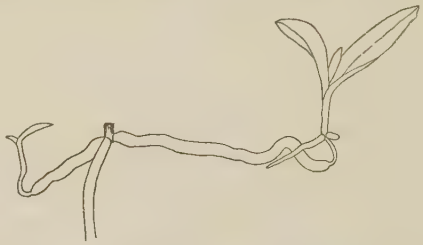
roseate) erect lobes: disc shallowly lobed: drupe dry, greenish-drab as in *C. umbellata*.— *C. umbellata*, Hook. Fl. Bor.-Am. ii, 139, in part, and t. 179 A, not Nutt.— Quebec, sandy alluvium of the Grand River, Gaspé County, July, 1903 (*G. H. Richards*), July 1, 1904 (*M. L. Fernald*); dry sandy woods, Tadousac, July 14, 1904 (*M. L. Fernald*), September 1, 1904 (*J. I. Collins & M. L. Fernald*): Ontario, woods near Belleville, May 22, 1878 (*J. Macoun*): Manitoba, Lake Winnipeg Valley, 1857–1859 (*E. Bourgeau*): Saskatchewan, Cumberland House (*Drummond*): Assiniboia, Sand Hills, Moose Mountain Creek, June 6, 1883 (*J. M. Macoun*): Wisconsin, St. Croix Falls, May, 1899 (*C. F. Baker*): Nebraska, Ponco, June 13, 1893 (*F. Clements*, no. 2519): Missouri, dry woods, St. Louis County, May 27, 1877, April 23, 1878 (*H. Eggert*): Kansas, Independence, 1882 (*E. N. Plank*).

Gray Herbarium.

VEGETATIVE REPRODUCTION OF SPIRANTHES CERNUA.

John Galentine Hall.

Among the orchids, in spite of the great amount of seed produced, we all know how difficult it is to find seedlings of our native species in their haunts. With this knowledge comes the question, how do they perpetuate themselves? In most cases the answer is quite plain. In Arethusa a new bulb is formed each year. This is also true of Calopogon and Microstylis. In Habenaria a specialized root is formed each year and gives rise to a new plant in the following spring. Pogonia has an extensive system of branching roots, which give off stems at various intervals. In *P. ophioglossoides* I have found roots six to eight feet long bearing ten to twenty stems upon them, and in *P. verticillata*



roots eighteen to twenty feet long giving rise to five or six separate stems. Here the new shoots arise as "adventitious" buds upon the upper side of the parent roots. The latter are doubtless enabled by this very trait of bud-bearing to continue their growth in length through several years and extend far beyond ordinary limits.

In *Spiranthes cernua* the method of vegetative reproduction is different, as will be seen from the following observations. Some years ago, when looking over in early spring some plants of this species that had been transplanted the year before, I noticed a number of small individuals that looked as if they might be seedlings. But on closer investigation they proved to be young plants of non-sexual growth, arising from the roots of the previous year and in most cases being developed from the tip of the root. At first I thought this might be a case of adaptation to the new conditions of growth in the garden after transplanting, but upon search in the field I found that a large number of cases showed the same phenomena, and I have recently found a similar development in *Neottia* referred to by Strasburger. It seems worth while therefore to call the attention of the readers of Rhodora to this noteworthy method of reproduction in one of our orchids. The accompanying sketch shows the manner of growth of the new plant. The most interesting aspect of the matter is that the tip of the root, which usually possesses a structure peculiar to itself, is here converted, as it appears directly into the growing point of a stem.

Cambridge, Massachusetts.

A NEW JUNCUS OF THE GROUP POIOPHYLLI.

Harley Harris Bartlett.

Juncus monostichus, sp. nov. — Erect, 3–5 dm. tall; culms compressed; leaves basal, from $\frac{1}{2}$–$\frac{3}{4}$ length of culm; blades 0.5–1.5 mm. broad, involute in drying; sheaths loose, mostly free, margins scarious; auricles produced, scarious; inflorescence 4–8 cm. long, much exceeded by its lowest bract, stramineous when mature; branches of inflorescence 1–2.5 cm. long, often incurved, bearing 3–9 conspicuously secund flowers; perianth-segments 4–5 mm. long,

lanceolate, acuminate, with hyaline margins; stamens six, about one-half as long as the perianth; anthers pale yellow, shorter than the filaments; capsule 2 mm. long, trigonous-obovoid, concealed by the closely appressed perianth; placentae not meeting in the axis; stigmas red-brown, reaching almost to tip of perianth; seeds few, ovoid, 0.5 mm. long by 0.2 mm. broad, coarsely reticulate in about 16 rows, areolae longitudinally oblong, 2–2½ times as long as broad.

The type specimens of *Juncus monostichus* were collected south of Anderson, Indiana, by Mr. Charles Piper Smith. He could not refer them to any described species, and very kindly gave me his material for further investigation. It was found to be closely related to *Juncus dichotomus* and *Juncus secundus*, but differed from both in its very small capsules, long basal leaves and large, longitudinally reticulate seeds.

Besides the type material, which has been divided between the Gray Herbarium and the writer's herbarium, there is a sheet in the Gray Herbarium from central Arkansas (F. L. Harvey, no. 9) which is referable to *Juncus monostichus*. The Arkansas plant is mature, but sterile. The capsules of the Indiana plant contain undeveloped ovules, and from one to ten mature seeds. Whether or not this sterile tendency is characteristic of the species, can be determined only by an examination of more material.

The range is, of course, undetermined. Probably a large part of the plants of the Mississippi basin which have been determined as *Juncus secundus* belong to the new species. *Juncus dichotomus* is included in S. Coulter's "Catalogue of the Flowering Plants and Ferns of Indiana," upon the authority of Dr. J. Schneck, whose collections were passed upon by Gray. Dr. Schneck's material should be re-examined, however, as it seems extremely improbable that the range of *Juncus dichotomus* extends as far west as Indiana. The writer will be glad to examine western plants which have been referred to either of the above species.

Gray Herbarium.

NOTES ON NEW ENGLAND HEPATICAE, — III.

Alexander W. Evans.

Since the publication of the second paper of this series[1] additions have been made to the hepatic floras of New Hampshire and Vermont. These additions include three species which are new to New England and which are referred to in the following pages. The other species noted are imperfectly described in the American literature. With the exception of *Cephalozia Sullivantii* and the *Jubula*, the species mentioned are all common to Europe.

1. Marsupella sparsifolia (Lindb.) Dumort. Hep. Eur. 128. 1874. *Sarcoscyphus sparsifolius* Lindb. Not. pro F. et Fl. Fenn. 9: 280. 1868. *Nardia sparsifolia* Lindb. *l. c.* 13: 370. 1874. Mt. Washington, New Hampshire (*W. G. Farlow*). This species has been collected by J. Macoun on Vancouver Island, but no other American localities for it have been recorded. Its discovery marks an interesting addition to the hepatic flora of eastern North America. In size, color, and general habit *M. sparsifolia* bears a close resemblance to *M. media*, and the structure of the stem is essentially the same in the two species. The leaves are also very similar, but in *M. sparsifolia* the divisions are usually obtuse instead of rounded, the reverse being the case in *M. media*. The most important differential character, however, is derived from the inflorescence, which is paroicous in *M. sparsifolia* and dioicous in *M. media*. A paroicous inflorescence is also exhibited by *M. ustulata*, but this species may be at once distinguished by its minute size and by the acute divisions of its leaves.

2. Lophozia Kunzeana (Hüben.) Evans, Proc. Wash. Acad. 2: 305. 1900. *Jungermannia Kunzeana* Hüben. Hep. Germ. 115. 1834. *J. plicata* Hartm. Fl. Scand. Ed. III. 2: 329. 1838. *J. colpodes* Tayl. Lond. Jour. Bot. 5: 280. 1846. *J. plicata* **Kunzeana* Hartm. Fl. Scand. Ed. X. 2: 137. 1871. *J. Kunzei β plicata* Lindb. Musc. Scand. 8. 1879. *Sphenolobus Kunzeanus* Steph. Bull. de l'Herb. Boissier, II. 2: 168. 1902. Mt. Washington, New Hampshire (*W. G. Farlow*). *Lophozia Kunzeana* has a wide distribution in

[1] Rhodora, 6: 165–174; 185–191. *pl. 57.* 1904.

the alpine and arctic regions of the Northern Hemisphere, although it is rarely abundant in any one locality. In North America it has already been recorded from Greenland, from several widely scattered stations in British America, and from the Adirondack Mountains of New York. It is, however, new to New England. Professor Farlow's specimens represent a gemmiparous and rather slender form of the species.

The leaves of *L. Kunzeana* vary in form from rotund to quadrate; they are subequally bifid and tend to be complicate, although this condition is not always apparent. In rare cases there is a third lobe supplementary to one of the others. The sinus is narrow and extends to the middle or a little less. The divisions are typically rounded at the apex but are often obtusely pointed or, on slender branches, even acute. The leaf-cells have small but distinct trigones, and the cuticle is minutely verruculose or striate. The underleaves vary greatly in size but can usually be demonstrated without much difficulty in spite of the numerous rhizoids. They are either subulate and long-acuminate or else deeply bifid with slender divisions. The gemmae when mature are thick-walled and angular; as a rule they are unicellular but are sometimes divided by a delicate wall into two cells. In exposed localities the stems, leaves and gemmae acquire a characteristic brownish yellow coloration.

The presence of underleaves will at once distinguish *L. Kunzeana* from such species as *Sphenolobus Michauxii*, *Marsupella emarginata* and *Lophozia inflata*, all of which it somewhat resembles in general appearance. Among New England species its closest relative is undoubtedly *L. Floerkii*, which has trifid or quadrifid leaves with a little group of marginal cilia close to the postical base. There is usually no indication whatever of basal cilia in *L. Kunzeana*, although sometimes one or two minute and indistinct teeth may be found in this position.[1] Its relationship to *L. Floerkii* and to other members of the *barbatae*-group is clearly shown by the occasional presence of a third lobe and by the constant occurrence of underleaves, and it would seem as if these characters were sufficient to exclude it from the genus *Sphenolobus*, where it is placed by Stephani.

3. Chiloscyphus pallescens (Ehrh.) Dumort. Syll. Jung. 67. 1831. *Jungermannia viticulosa* L. *p. p.* Sp. Plant. 1597. 1753. *J.*

[1] See Schiffner, Lotos, 49: 51. 1901.

pallescens Ehrh. Crypt. Exsic. *502*; Hoffmann, Deutschlands Flora, 2: 87. 1795. *J. polyanthos β pallescens* Lindenb. Nova Acta Acad. Caes. Leop.-Carol. 14, suppl.: 30. 1829. *Chiloscyphus lophocoleoides* Nees, Naturgeschichte der europ. Lebermoose, 2: 365. 1836. *J. ascendens* Hook. & Wils.; Drummond, Musc. Amer. St. Merid. *165*. 1841. *C. labiatus* Tayl. Lond. Jour. Bot. 5: 284. 1846. *C. ascendens* Sulliv. Gray's Manual, Ed. I. 691. 1848; Ed. II. 691. *pl.* 7. 1856. *C. polyanthos β pallescens* Hartm. Fl. Scand. Ed. X. 2: 145. 1871. *C. polyanthos β viticulosus* Lindb. Not. pro. F. et Fl. Fenn. 13: 354. 1874. *C. viticulosus* Lindb. Acta Soc. Sc. Fenn. 10: 505. 1875. On rotten logs, rarely on shaded banks rich in humus. Mountains of New England (*W. Oakes*). Jackson, New Hampshire (*A. W. E.*). Connecticut: Bethany (*D. C. Eaton*); Oxford (*E. B. Harger*); Woodbridge and Salisbury (*A. W. E.*). Although *C. pallescens* has long been recognized by European botanists, it has usually been regarded as a variety of the common and widely distributed *C. polyanthus*. The most reliable characters separating the two species are drawn from the leaf-cells and from the perianth. In *C. polyanthus* the cells are usually less than 30 μ in diameter, and the lobes of the perianth are entire or nearly so; in *C. pallescens* the cells measure 35–40 μ or even more, and the lobes of the perianth are more or less dentate or lacerate. *C. polyanthus*, moreover, grows in very wet localities, sometimes on the earth or mixed with mosses in swamps, sometimes affixed to stones in running water, sometimes floating in shaded pools. Both species are autoicous in their inflorescence.

According to the published descriptions *C. ascendens* and *C. pallescens* are very closely related species, but differ from each other in their underleaves, those of *C. ascendens* being quadrifid while those of the other species are only bifid. This difference, however, is most inconstant. The underleaves of *C. ascendens*, as a matter of fact, are deeply bifid, just as in *C. pallescens*, the divisions being long and slender and tapering out into hair-like points. Sometimes these divisions are entire; sometimes one or both of them will show a short tooth, rarely more than three cells long, close to the base. These teeth give a trifid or quadrifid appearance to the underleaves; but, as similar teeth may also be found in European material of *C. pallescens*, they cannot yield differential characters of importance. It seems necessary, therefore, to consider *C. ascendens* a simple synonym of *C. pallescens*.

As the synonymy shows Lindberg took up for *C. pallescens* the old Linnaean name *viticulosus*. *Jungermannia viticulosa* L., however, was an aggregate and was based on two figures, the one by Micheli[1] and the other by Dillen.[2] Micheli's figure is quoted first and ought therefore to be considered as representing the type of the species. This figure shows a widely distributed European plant, now universally known as *Saccogyna viticulosa* (L.) Dumort. Dillen's figure, on the other hand, represents *C. pallescens*.[3] In order, however, to supplant Ehrhart's specific name *pallescens* by the older name of Linnaeus, it would be necessary to recognize two distinct Linnaean species, both bearing the name *J. viticulosa*, a proceeding which could hardly be recommended.

4. Cephalozia myriantha Lindb. Medd. Soc. F. et Fl. Fenn. **1**: 110. 1876. *C. Jackii* Limpr.; Spruce, On Cephalozia, 67. 1882. Amesbury, Massachusetts (*J. W. Huntington*). It has lately been shown by Schiffner [4] that the characters which were supposed to separate *C. Jackii* from *C. myriantha* are inconstant and of minor importance. He therefore considers them synonyms and takes up for the species Lindberg's name, which is several years older than Limpricht's. A change to this effect should accordingly be made in the writer's Preliminary List of New England Hepaticae.[5]

5. Cephalozia Sullivantii Aust. Hep. Bor.-Amer. *50*. 1873. *Jungermannia Sullivantii* Aust. Proc. Acad. Philadelphia for 1869: 221. Chocorua, New Hampshire (*W. G. Farlow*). This rare species is new to New England; it has been previously reported from Ontario, Ohio and New Jersey. It is an exceedingly minute plant, smaller even than *C. divaricata*, and has always been found on rotten logs. In all probability it has been overlooked on account of its inconspicuousness. It agrees with *C. divaricata* in its dioicous inflorescence but differs in its relatively more fleshy stem and in its much smaller leaves. Professor Farlow's specimens are all male and show dentate perigonial bracts.

6. **Jubula pennsylvanica** (Steph.) comb. nov. *Frullania Hutchinsiae* and *Jubula Hutchinsiae* Auct. (in part), not *Jungermannia*

[1] Nov. Plant. Gen. *pl. 5, f. 4*. 1729.
[2] Hist. Musc. *pl. 69, f. 7*. 1741.
[3] See Lindberg, Hepat. Utveckl. 28, 33. 1877.
[4] Oesterr. Bot. Zeitschr. **54**: 251. 1904.
[5] Rhodora, **5**: 170–173. 1903.

Hutchinsiae Hook. (=*Jubula Hutchinsiae* Dumort.). *Frullania Hutchinsiae* var. β G. L. & N. *p. p.* Syn. Hep. 775. 1847. *F. Hutchinsiae* var. β *integrifolia* Lindb. *p. p.* Acta Soc. Sci. Fenn. **10**: 474. 1875. *F. pennsylvanica* Steph. Hedwigia, **22**: 147. 1883. *F. Hutchinsiae* var. Underw. Bull. Illinois State Lab. Nat. Hist. **2**: 65. 1884. *Jubula Hutchinsiae* var. *Sullivantii* Spruce, Hep. Amaz. et And. 62. 1884. Maine: Mt. Desert (*E. L. Rand*). New Hampshire: Chocorua (*W. G. Farlow*); Jackson (*A. W. E.*). Vermont: Brattleboro (*C. C. Frost*). Connecticut: Hamden (*D. C. Eaton*); Cheshire, Beacon Falls, Woodbridge, Salisbury,[1] Middletown and Rainbow (*A. W. E.*). The known range of the plant extends from Nova Scotia to Georgia and westward to Tennessee.

Jubula Hutchinsiae is regarded by the majority of writers on the hepaticae as a variable species with a very wide geographical distribution. The type specimens were collected by Miss Hutchins, at Bantry, Ireland, about a hundred years ago, and the typical form of the species is now known in Europe from scattered stations in the British Isles and from a very few localities in western France. Throughout its entire range it is rare or extremely local. The *Jubula* noted above has usually been referred to *J. Hutchinsiae* as a variety, although its very aberrant characters have long been recognized. Other divergent forms are known from Madeira, from tropical America, from Japan and the East Indies and from various islands of the Pacific. A *Jubula* from the Hawaiian Islands has already been separated as *J. piligera* (Aust.) Evans,[2] *J. japonica* Steph. has recently been described from Japan,[3] and it is probable that other species of the genus will in time be considered distinct.

In the true *J. Hutchinsiae* the leaves are characterized by their spinose-dentate margins, the teeth varying in number from two to twelve but averaging five or six. Most of these teeth are from four to six cells long and two or three cells wide at the base, and the apical tooth is usually a little larger than the others. The lobule is helmet-shaped and inflated, with a broad and truncate mouth, and, at the outer basal angle, is often extended in the form of a

[1] These specimens were collected in Sage's Ravine, very close to the Massachusetts line. In the writer's Preliminary List, they are accredited to Massachusetts; this record should therefore be revised.

[2] Trans. Conn. Acad. **10**: 406. *pl. 47, f. 12–20.* 1900.

[3] Bull. de l'Herb. Boissier, I. **5**: 92. 1897.

slender hair-like spur, about four cells long and one or two cells wide at the base. According to Gottsche[1] this spur represents the true apex of the lobule. If the conditions for growth are unfavorable the lobule often fails to develop a water-sac and then consists of a small pointed lamina, which is sometimes so reduced as to be scarcely apparent. The underleaves are bifid, with slender acuminate divisions, and are either entire on the margins or bear one or two lateral hair-like teeth.

In *J. pennsylvanica* the leaves vary from rounded or obtuse at the apex to apiculate, the apical tooth being rarely more than two or three cells long; the margin is otherwise entire. The lobule is invariably without a spur and is often slightly narrowed at the mouth. The divisions of the underleaves are sometimes blunt but are usually acuminate, and the margins, in rare instances, are angular-dentate on the sides; as a rule, however, the margins are quite entire.

The differences noted in the leaves also appear in the bracts, although possibly in a less degree. In both species the bracts are deeply and subequally bifid. In *J. Hutchinsiae* the lobe is ovate and long-acuminate, and there are several spine-like teeth on the margin; the lobule is also acuminate but is commonly entire. In *J. pennsylvanica* both lobe and lobule are broader than in the other species and are abruptly apiculate or acuminate at the apex; the margins are entire. The bracteoles in both species are deeply bifid with acuminate divisions, but those of *J. Hutchinsiae* taper more gradually and usually bear a few spinose teeth on the margin, instead of being entire.

Lindberg's variety *integrifolia*, based primarily on Irish specimens, is not wholly destitute of teeth. It seems to be little more than an attenuate and poorly developed form of *J. Hutchinsiae*, and is so regarded by Pearson and other European writers. The specimens figured by Moore[2] are practically without lobules and present a very different appearance from robust and well-developed forms of *J. pennsylvanica*.

In the opinion of the writer *J. pennsylvanica* represents a distinct species with a definite geographical distribution. The entire leaves and the lobules without spurs afford reliable differential characters.

[1] G. & R. Hep. Europ. *477* (note).
[2] Proc. Roy. Irish Acad. II. 2 : *pl. 45*. 1877.

It grows on shaded rocks in very moist localities and prefers situations where it may be thoroughly soaked by dripping water.

Aside from the species noted in the preceding pages the following additions have been made to the flora of New Hampshire: *Asterella tenella* and *Reboulia hemisphaerica*; Cornish (*Miss Haynes*). *Riccardia palmata* and *Cephalozia fluitans*; Chocorua (*W. G. Farlow*). *Cololejeunea Biddlecomiae*; Cornish (*Miss Haynes*) and Hanover (*A. LeR. Andrews*). *Frullania Brittoniae* and *Lophocolea minor*; Cornish (*Miss Haynes*). *Mylia anomala*; Chocorua (*W. G. Farlow*). *Anthoceros punctatus* and *Notothylas orbicularis*; Cornish (*Miss Haynes*).

The additions for Vermont are the following: *Fossombronia Wondraczeki*; Newfane (*A. J. Grout*). *Pallavicinia Lyellii*; Willoughby (*Miss Lorenz*). *Nardia obovata*; Manchester (*A. J. Grout*).

In the Preliminary List of New England Hepaticae several records are marked with the sign "—", showing that they were known to the writer from printed reports only. It is perhaps worthy of note that, in the following cases, the sign "—" may now be replaced by the sign "+". For Vermont: *Riccia fluitans*, *Asterella tenella*, *Riccardia multifida*, *Chiloscyphus polyanthus*, *Lophozia incisa*, *Nardia crenulata*, *Anthoceros laevis* and *A. punctatus*. For Massachusetts: *Harpanthus scutatus*, *Lophocolea bidentata* and *Sphenolobus exsectus*. For Rhode Island: *Cephalozia connivens* and *Trichocolea tomentella*.

The Rhode Island records, on the other hand, for *Lophozia barbata*, *Porella pinnata* and *Anthoceros punctatus* seem to have been based on incorrect determinations. Although it is hardly probable that these species are actually absent from the Rhode Island flora, they ought to be omitted for the present from lists of Rhode Island plants. The Massachusetts records, also, for *Lophozia gracilis* and *Sphenolobus Michauxii*, as well as for *Jubula pennsylvanica* (see page 56, footnote), were based on specimens collected in Sage's Ravine, Salisbury, Connecticut. They ought therefore to be accredited to the latter state.

With these additions and subtractions the census of New England Hepaticae now stands as follows: Total number recorded, 131; number recorded from Maine, 79; from New Hampshire, 99; from Vermont, 81; from Massachusetts, 80; from Rhode Island, 62; from Connecticut, 96; from all six states, 36.

YALE UNIVERSITY.

Meeting of the Vermont Botanical Club. — The tenth annual winter meeting of the Vermont Botanical Club was held at Burlington, January 18–19, 1905. President Ezra Brainerd of Middlebury College presided and the following papers were read: — A Report of the Last Field Meeting, Mrs. Mary A. Munson; The Fossil Fruits of the Brandon Lignite, Prof. G. H. Perkins; Notes on the Fruiting Season of the Moss, Catherinia, Miss Phebe M. Towle; Nitrogen-fixation by Leguminous Plants, L. P. Sprague; The Story of a Maple Tree, J. A. Chapin; Another Giant Puff-ball from Middlebury, Mrs. Sarah K. Lord; Hunting Pines in Mexico, C. G. Pringle; The Aquarium in the School and the Home, H. F. Perkins; Reminiscences of Europe, Prof. L. R. Jones; Prof. Henry G. Jesup, the Botanist and the Man, Dr. C. H. Richardson; On a Botrychium new to Massachusetts, Mrs. E. B. Davenport; The Conception of Species as indicated by the Study of the Genus Viola, President Ezra Brainerd; Breeding Plants for Disease Resistance, W. A. Orton; Experiments in Plant Breeding, Prof. William Stuart; Studies of the Potato Fungus, W. M. Gambell; An Experience with one of the Fungi producing Dry-rot in Timber, Mrs. Nellie F. Flynn; Agriculture for Normal Students, Miss Ruth B. Fisher; Pursh's Journal, W. W. Eggleston; Blackberries and Raspberries, W. H. Blanchard; Ferns of Dorset, Allan Bourn; Additional Species of Vermont Mosses, A. J. Grout; Notes on Some Plants from Matinicus Island, Me., J. A. Bates.

On the evening of the 18th supper was served in the gymnasium of the University of Vermont, complimentary to the non-resident members of the club. This social gathering, which was one of the most pleasing features of the meeting, was followed by the annual roll-call and business meeting. Each member, according to the custom of the club, presented some item of botanical interest in responding to his name. The old officers were re-elected. The treasurer's office was made independent of that of the secretary and Mrs. Nellie F. Flynn was elected to fill the former position. Prof. J. W. Votey, Mrs. Sarah K. Lord, and Mr. Carleton D. Howe were appointed to serve with the officers as members of the new Executive Committee. The officers were instructed to petition the Post Office Department to re-establish the office at Willoughby Lake. The post office at this well known station of botanical interest, after sixteen years' existence, was discontinued about a year ago. For the summer meeting of the Club a boat will probably be chartered for a cruise among the islands and along the shores of Lake Champlain. — W. J. Morse, Burlington, Vermont.

A well marked Species of Sparganium.— Among the Bur-reeds of New England there is none which can be more readily recognized than a plant which grows in deep water of cold lakes. Its salient features are a branched inflorescence, sessile heads, short oblique stigma, and firm-coated oblong-fusiform fruit ending in a stouitsh rather rigid falcate beak. Most of our other bur-reeds show a preference for shallower or warmer water, wet sandy shores, etc., and none of them shares the traits of or show any intergradation with this well marked species, which may be characterized as follows:

Sparganium fluctuans, n. comb. *S. simplex*, var. *fluitans*, [Engelm. in] Gray, Man. ed 5, 481 (1867), not *S. fluitans*, Fries. *S. androcladum*, var. *fluctuans*, Morong, Bull. Torr. Bot. Club, xv. 78 (1888); Britt. & Br. Ill. Fl. i. 64 (1896). Gracile vel mediocriter robustum, 2.6–15 dm. longum; basi erecta alte immersa, parte superiori foliorum natante; radice e fibris numerosis flavo-brunneis composita; foliis linearibus leviter carinatis 3–11 mm. latis, basalibus perlongis, caulinibus gradatim brevioribus, bractealibus 3–12 cm. longis basi paululum saccato-ampliatis; inflorescentia ramosa, ramis saepissime 3 capita arcte sessilia 1–2 inferiora ♀ 2–4 superiora ♂ gerentibus; capitibus ♀ ad maturitatem 2 cm. diametro; stylo unico leviter curvato, stigmate obliquo ovale vel brevissime oblongo; fructu fusiforme vel media parte subcylindrico vel etiam subconstricto, apice in rostrum firmiusculum falcato-gladiatum persistentem attenuato, exocarpo firmo laevi vel obscure striatulo.— Cold lakes and ponds, Western Central Maine to southern Quebec, Connecticut, and Minnesota. Specimens examined: — Quebec: L. Memphremagog, 1 Aug. 1903, *Churchill*. Maine: Cambridge, *Bunker*; Sweet's Pond, New Vineyard, 15 Aug. 1894, *Fernald*; Pease Pond, Wilton, 11 Aug. 1894, *Fernald*; Hartford, July, 1886, *Parlin*; E. Auburn, *Merrill*, no. 381. New Hampshire: Ponds at base of White Mts. *Oakes*. Vermont: Chittenden Pond, 18 Aug. 1895, *Eggleston*; L. Dunmore, 11 Aug. 1896, *Brainerd*; Wallingford, 4 Sep. 1898. Eggleston. Connecticut: Nettleton's Pond, Norfolk, Sep. 1864, *Robbins*. L. Superior: *Beardslee*. Minnesota: Vermilion Lake, *Arthur, Bailey, & Holway*, No. B. 83.— B. L. Robinson, Gray Herbarium.

Vol. 7, no. 74, including pages 21 to 40, was issued 26 February, 1905.

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